# From Lab to Marketplace

Successfully navigating the so-called 'valley of death,' more than 100 lighting technology demonstrations have been completed under the CLTC model

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New technologies face a multitude of market introduction barriers that must be overcome before the technology becomes stable and successful. These barriers include a lack of customer knowledge, few marketing and distribution channels, excessive purchase and installation mark-ups from designers and installers, and consumer mistrust of savings and benefits.

The California Lighting Technology Center (CLTC) at the University of California, Davis has implemented a successful Demonstration Program to help emerging, energy-efficient lighting technologies cross this "valley of death" and gain a foothold in the mainstream marketplace. The Demonstration Program employs a variety of technology transfer activities, including product demonstrations, case studies, fact sheets, guide specifications, market education and training, group purchasing, public specifications, code changes, and utility incentives.

The lighting demonstration program is one component of the California Energy Commission's Public Interest Energy Research (PIER) State Partnership for Energy Efficiency Demonstrations (SPEED) program. The SPEED program applies newly developed building technologies and deployment approaches throughout a wide range of venues, including the University of California, California State University, and California Community College campus systems; the California Department of General Services; and cities, municipalities, and military and private partners.

More than 100 lighting demonstrations have been completed as part of the program. These research, development and demonstration (RD&D) projects have produced energy-efficient technologies and practices ready for demonstration and large-scale deployment.

From March 2004 through June 2010, SPEED facilitated the market adoption of several technologies, including smart bi-level interior and exterior lighting, integrated classroom lighting, integrated office lighting, and wireless lighting controls. As a result, PIER technologies were included in California Public Utility Commission/Investor Owned Utility-administered implementation and incentive programs, and multiple nationwide energy-efficiency programs.

## HOW IT WORKS

The typical demonstration process begins by matching new lighting technologies with a potential host site. Program team members produce a project brief that describes existing lighting conduction and products; recommendations for energy-efficient demonstration alternatives; and expected energy savings and photometric performance of the recommended technologies. Once the project is approved, a more extensive site survey usually is conducted to produce detailed engineering information required for the lighting retrofits, including monitoring and verification requirements.

Site personnel review the detailed project information, and then pre-retrofit monitoring equipment is installed and data collected for parameters appropriate to the technology and site conditions. Retrofit lighting technologies are procured, with materials and/or installation often provided in-kind by the host site. The retrofit process includes project commissioning, which sometimes extends to resolving technical issues identified through the post-retrofit monitoring process. Once an adequate period of satis-

factory monitoring produces the necessary energy, usage and photometric data, data analysis is performed to establish site-specific technology performance. The technology performance then is evaluated with site personnel, and the results typically are documented in a case study.

Case studies and other project information tools are developed to help the host site and other organizations evaluate the technology for use in additional products and applications. Demonstration performance information also may be used as feedback to the RD&D process, which may include a derivative product development process. Derivative products are equivalent products from new manufacturers, newer improved offerings of products improved at least partly as a result of information obtained during the demonstration process, or new classes of products for new applications developed at least partly as a result of the demonstration process.

## DEMONSTRATED SUCCESSES

What follows are some key CLTC/industry demonstrations executed over the past several years.

***Bi-level parking garage luminaires.*** These luminaires integrate intelligent controls with bi-level electronic drivers or ballasts to control light output based on garage occupancy. Luminaires operate at a reduced level during vacancy and switch to full light output upon occupancy. Many of the products may be combined with traditional photocontrols to maximize energy savings. CLTC worked with several entities to develop bi-level parking garage luminaires, available with LED and induction sources.

### LIGHTING TECHNOLOGIES DEMONSTRATED BY CLTC

**Interior**

- Bi-level luminaires for stairwells, corridor and other secondary spaces
- Integrated Classroom Lighting System and derivatives
- Bathroom smart fixtures and switches
- Integrated Office Lighting System/Personal Lighting System
- Load shed ballast
- Digital addressable lighting systems
- Energy-efficient CFL and LED downlights
- Wireless lighting controls
- Simplified daylighting controls

**Exterior**

- Low-glare outdoor wall packs
- Smart HID, induction and LED wall packs
- Smart LED bollards
- Smart fluorescent, LED and induction parking garage luminaires

### DIRECT SAVINGS FROM LIGHTING DEMONSTRATION PROGRAM

- Annual electricity savings: 932,000 kWh
- Annual carbon emissions avoided: 643,000 lbs
- Annual avoided energy cost: $121,000

### MARKET POTENTIAL FOR DEMONSTRATION PROGRAM LIGHTING TECHNOLOGIES

- Annual electricity savings: 1.5 million to 3.7 million MWh
- Annual carbon savings: 517,000 to 1.2 million tons
- Annual cost savings: $194 million to $487 million

The LED fixture was a collaboration between CLTC; Sacramento Municipal Utility District (SMUD); the California Energy Commission; California State University, Sacramento (CSUS); and BetaLED. The luminaire purposefully uses a high wattage (165 watts) so that the minimum lighting requirements are met in low mode (77 watts). BetaLED's The Edge parking garage luminaire was demonstrated in parking structures at CSUS and UC Santa Barbara. It replaced 150-W high-pressure sodium luminaires for an average energy savings of 466 kWh or 31 percent. Several manufacturers now offer derivatives of this product.

The induction luminaire was a collaboration between CLTC; UC Davis; the Energy Commission; Everlast Lighting;

WattStopper; and Pacific Gas and Electric Company (PG&E). UC Davis Facilities and Transportation and Parking Services also contributed to the project. The Everlast step-dimming parking garage luminaire was demonstrated at the University of California, Santa Barbara and UCD, and ultimately was incorporated in all UCD parking garages. The fixture automatically reduces to 50 percent power on vacancy (43 watts) and increases to 100 percent power on occupancy (115 watts), and uses a fixture-integrated occupancy sensor. The luminaires replace 100-W HPS for energy savings of 936 kWh or 57 percent.

***Bi-level street and parking area luminaires.*** CLTC used the parking garage luminaire concept to develop products for street and parking area luminaires using LED and induction sources. This was a collaborative effort between BetaLED; Everlast Lighting; Southern California Edison; and California Polytechnic State University, San Luis Obispo.

The LED fixture (from BetaLED) was demonstrated at UC Davis and Cal Poly and is still a part of the PIER Demonstrations portfolio. The luminaire uses 118 watts in high mode and 39 watts in low mode and usually replaces 250-W HPS, for energy savings of 246 kWh or 32 percent. It has evolved into many different luminaire offerings and application types for exterior lighting. All the luminaires use the original light bar concept, and multiple bi-level controls options are available.

The induction fixture (from Everlast Lighting) also was demonstrated at UC Davis and Cal Poly and is still used in the PIER Demonstrations portfolio. The luminaire uses 110 watts in high mode and 55 watts in low mode and usually replaces 100-W HPS, for energy savings of 889 kWh or 74 percent. It has evolved greatly to include many induction applications, many fixture types and a high fixture efficiency.

If these energy-efficient, bi-level luminaires were implemented in all parking and areas lighting applications statewide, California could expect to save 426,000 to 442,000 MWh; 61,000 to 153,000 tons of $CO_2e$; and $23 million to $57 million.

***Bi-level stairwell luminaires.*** These luminaires were developed by CLTC and the New York State Energy Research Development Agency (NYSERDA) and were demonstrated at numerous college campuses across California through a joint purchasing program. Multiple manufacturers now produce derivatives of the luminaires, and the concept has evolved to include corridor lighting. The stairwell luminaires operate at 58 watts in high mode and 29 watts in low mode. They generally replace two-lamp T8 fixtures with magnetic and electronic ballasts, for an energy savings of 48 kWh or 62 percent. If bi-level stairwell luminaires were implemented statewide, California could expect to save 22,000 to 55,000 MWh; 7,500 to 19,000 tons of $CO_2e$; and $2 million to $7 million.

**An LED downlight prototype from Cooper Halo was tested at the Bidwell Mansion Visitor Center.**

**A bi-level, cobra-head induction fixture tested at the UC Davis campus continues to show potential.**

***LED downlights.*** The LED downlight was a collaboration between CLTC; the California Department of Parks and Recreation; the Energy Commission; Cooper Lighting; and Lighting California's Future. An LED downlight prototype was produced for retrofits and new construction projects and was demonstrated at the Bidwell Mansion Visitor Center in Chico, CA. Cooper Halo now produces this LED downlight, and several derivatives of this product now are available on the market. The downlight usually replaces CFL downlights in retrofits, for an energy savings of 770 kWh or 49 percent. If LED downlights were implemented statewide, California could expect to save 426,000 to 1 million MWh; 147,000 to 368,000 tons of $CO_2e$; and $55 million to $138 million.

***Integrated Office Lighting System (IOLS).*** CLTC originally developed the concept for the IOLS in response to California's ever-stricter Title 24 standards requirements. The IOLS is designed to provide lower overall ambient light levels for general use and additional illuminance at the task level with LED task lights, increasing an office's energy efficiency. CLTC partnered with Finelite to produce the Personal Lighting System (PLS), which capitalizes on this concept using LED task lights. The IOLS and PLS have been demonstrated at the Sacramento Department of Motor Vehicles and the California Department of Public Health in Richmond. Multiple companies now produce energy-efficient pendants and troffers that are used in PIER-sponsored demonstrations and retrofits. The IOLS typically replaces fluorescent pendants, and incandescent and fluorescent task lights, for energy savings of 43,500 kWh or 57 percent. If these luminaires were implemented statewide, California could expect to save 321,000 to 802,000 MWh; 111,000 to 277,000 tons of $CO_2e$; and $42 million to $104 million.

## THE FUTURE IS BRIGHT

CLTC's Demonstration Program continues to facilitate market adoption of new technologies through ongoing demonstrations, special technology transfer projects and market transformation activities in follow-on phases. This will lead to continued energy conservation, more successful lighting technology manufacturers and perhaps most importantly, more satisfied consumers, who expect products to be successfully tested before they reach the market. ■


### THE AUTHORS

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**Tested at California college campuses, bi-level stairwell luminaires operate at 58 watts in high mode and 29 watts in low mode.**

**The Integrated Office Lighting System relies on lower overall light levels supplemented by LED task light.**